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OFFICE OF
PREVENTION, PESTICIDES
AND TOXIC SUBSTANCES

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MEMORANDUM

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SUBJECT: Tier II Estimated Drinking Water Concentrations (EDWCs) for Human Health Risk for oxadiazon on Florida Golf Course

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This memo presents the Tier II surface drinking water assessment for oxadiazon. The EDWCs for oxadiazon were based on the proposed maximum application rate (8.0 lbs a.i./A, 3 applications) on golf coarse, which constitute the major use of the chemical. The mean values of EDWCs over a 36-year period based on Florida Turf Scenario for various segments of the golf course (green, tees, fairways, and rough) are summarized in Table 1. Adjustments can be made to calculate cumulative EDWCs for various segments of the golf coarse by adding EECs for each segment of interest. For example, the sum of the chronic EDWCs for green, tees and , fairways would be 20.73 (i.e. 2.10+18.63) **$\mu g\ L^{-1}$**.

Table 1. Recommended EDWCs of Oxadiazon for human health risk assessment.

Exposure	**Greens & Tees**	**Fairways**	**Roughs**	**Golf Coarse**
		------------------(**$\mu g\ L^{-1}$**)------------------		
Acute (1/10 peak value)	7.7	44.28	128.65	180.63
Non-cancer Chronic (1/10 yearly value)	2.76	15.87	46.24	64.87
Cancer Chronic (Mean 36-year annual concentration)	2.10	18.63	35.22	55.95

Note: $\mu g\ L^{-1}$ = ppb

1.0 Estimation of surface water exposure concentrations

The maximum application rate and relevant environmental fate parameters for oxadiazon were used in the Tier II model (PRZM/EXAMS) for EDWCs in the surface water. The output of the screening model represent an upper-bound estimate of the concentrations of oxadiazon that might be found in surface water due to use of oxadiazon on golf coarse.

2.0 Background Information on PRZM/EXAMS simulation

PRZM/EXAMS modeling using the Index Reservoir (IR) and the Percent Crop Area (PCA) adjustment was used to estimate concentrations in surface water used as a source of drinking water. The index reservoir represents a watershed that is more vulnerable than most used as drinking water sources. It was developed from a real watershed in western Illinois. The index reservoir is used as a standard watershed that is combined with local soils, weather, and cropping practices to represent a vulnerable watershed for each crop that could support a drinking water supply. If a community derives its drinking water from a large river, the estimated exposure would likely be higher than the actual exposure. Conversely, a community that derives its drinking water from smaller bodies of water with minimal outflow would likely get higher drinking water exposure than estimated using the index reservoir. Areas with a more humid climate that use a similar reservoir and golf coarse turf management practices would likely get more pesticides in their drinking water than predicted levels.

A single steady flow has been used to represent the flow through the reservoir. Discharge from the reservoir also removes chemical from it so this assumption will underestimate removal from the reservoir during wet periods and overestimates removal during dry periods. This assumption can both underestimate or overestimate the concentration in the reservoir depending upon the annual precipitation pattern at the site. The index reservoir scenario uses the characteristic of a single soil to represent all soils in the basin. Soils can vary substantially across even small areas, thus, this variation is not reflected in these simulations.

The index reservoir scenario does not consider tile drainage. Areas that are prone to substantial runoff are often tile drained. This may underestimate exposure, particularly on a chronic basis (the watershed on which the IR is based had no documented tile drainage). Additionally, EXAMS is unable to easily model spring and fall turnover which would result in complete mixing of a chemical through the water column during these events. Because of this inability, Shipman City Lake has been simulated without stratification. There is data to suggest that Shipman City Lake does stratify in the deepest parts of the lake at least in some years. This may result in both an over and underestimation of the concentration in drinking water depending upon the time of the year and the depth the drinking water intake is drawing from. A full description of the Index Reservoir is provided in the "*Guidance for Use of the Index Reservoir in Drinking Water Exposure Assessment*" from EFED upon request.

Development a Percent Crop Area (PCA), watershed-based adjustment factor for the percent of land in production for golf coarse has not been performed. Therefore, the drinking water concentrations for oxadiazon were estimated using adjusting factors recommended in the EFED guidance document for the turf scenario (Carleton, et.al., 2001). The predicted concentrations are multiplied by 0.04 (fractional area analogous to PCA) for an average green and tee areas, 0.23 (fractional area analogous to PCA) for fairways, and an average 0.67 (fractional area analogous to PCA) for roughs (Appendix A). These multipliers were comparable to the surveyed data conducted by the Golf Course Superintends

Table 2. PRZM/EXAM Input Parameters for Oxadiazon

Parameters and Units	Oxadiazon	Source
PC Code	1090001	
Molecular Weight (g $Mole^{-1}$)	345.2	Product Chemistry
Vapor pressure (Torr)	1.0 E-6	Product Chemistry
Water solubility (mg $L^{-1)}$ †	1.0	Product Chemistry
Hydrolysis half-life @ pH 5 (Days)	Stable	MRID 41863603
Hydrolysis half-life @ pH 7 (Days)	Stable	MRID 41863603
Hydrolysis half-life @ pH 9 (Days)	38	MRID 41863603
Aerobic soil metabolism $t_{½}$, (Days)*	841	MRID 42772801
Aerobic aquatic metabolism (Days)*	1682**	EFED Guidence
Anaerobic aquatic metabolism (Days)*	≈365	MRID 42773802
Direct Aqueous Photolysis (Days)	2.75	MRID 41897201
Soil Water Partition Coefficient (K_{oc}, L Kg^{-1})	2352	MRID 1898202
Florida Turf Management		
Pesticide Application Rates (lbs a.i./A)	2.0 and 4.0	SRRD
Application Frequency	2X and 1X	SRRD
Application Interval (days)	30 and 135	SRRD
First Application Date	March 15	SRRD
Spray Efficiency	99%	EFED
Spray Drift	6.40%	EFED
PCA***		EFED
Green and Tees	4.00%	
Fairways	23.00%	
Roughs	67.00%	

† = Water solubility was multiplied by 10 according to Guidance for selecting input parameters in modeling for environmental fate and transport of

* = Selected input parameters were multiplied by 3 according to Guidance for selecting input parameters in modeling for environmental fate and

** = 2X of soil aerobic metabolismhalf-life input value.

*** = Fractional use area analogous to percent crop area

Association of America. They reported that an average for teeing areas is 2%, putting green 2%, fairways 23%, rough/wood/water 70%, and building and grounds 3% and that an average of 150-200 acres of total land is used for an 18-hole golf course facility.

The linked PRZM and EXAM model is typically used by EFED in estimating pesticides concentrations in surface waters. PRZM is employed to evaluate runoff loading to a receiving surface body. As soon as the pesticides residues reaches the surface water, EXAMS uses algorithms to estimate the pesticides concentrations by taking into account different dissipation mechanisms in the aqueous and sediment phases, weather patterns, and periodic application of pesticides for several years.

3.0 Florida Turf Scenario

This scenario based on the the EFED standard citrus scenario, models a field located in Osceola County, Florida in the Adamsville sand, a hyperthermic, uncoated Aquic Quartzipsamment in MLRA 156A. The Adamsville sand is a somewhat poorly drained, rapidly permeable soil that formed in thick sandy marine sediments occurring in Central and Southern Florida on slopes of 0-5 percent. Adamsville sand ranges from a Hydrologic Group A soil to a Hydrologic Group C soil, depending on the water table. For the purpose of this modeling, EFED used the curve number~~s~~ from the PIC of the Adamsville sand as a Group C soil. Runoff from application on turf was modeled using the EFED standard turf scenario (Carleton, et.al., 2001).

To develop a turf scenario the citrus scenario was modified by adding a 2 cm thick layer of “thatch” on top of the soil profile. The thatch layer has the following properties: bulk density = 0.37; field capacity = 0.47; wilting point = 0.27; organic carbon = 7.5%. Curve numbers were selected based on “good condition” open space areas as specified in TR-55, that for hydrologic soil group~~s~~. A 2 cm layer of thatch is typical for golf course fairways, but is probably thicker than average for golf course greens.

Turf is considered to be essentially generic, with no distinction made between sod farms, golf course fairways, greens and tees, or residential lawns. For chemicals applied to golf courses, the fraction of the total area composed of greens, tees, and fairways may, however be used to modify the results of a modeling run, somewhat in the fashion of a percent cropped area (PCA) adjustment. The approximate average percent areas (confirmed by Mike Kenna, USGA, personal communication) are as follows: fairways, 23%; greens, 2%; tees, 2%. Thus if a pesticide is only used on greens and tees, for example, the modeling results would be multiplied by a factor of 0.04.

4.0 Modeling Inputs and Results

The weather, golf coarse management practices, and oxadiazon applications were simulated over 36 years so that the ten year excedence probability at the site could be estimated. The EDWC’s generated in this analysis were estimated using PRZM 3.12 (Pesticide Root Zone Model) for simulating runoff and erosion from the agricultural field and EXAMS 2.97.5 (Exposure Analysis Modeling System) for estimating environmental fate and transport in surface water. Table 2 summarizes the input values used in the Florida Golf Coarse model run for PRZM/EXAMS. Attached to this memo is a copy of the printout generated from the PRZM/EXAMS run (See Appendix A).

5.0 References

Carleton, J., J. Lin, and M. Corbin. 2002. Development of a modeling approach to estimate runoff of pesticide residues from managed turf grass. Memorandum issued on February 27, 2002 on the subject “PRZM Standard Crop/Location Scenarios, Procedure to Develop and Approve New Scenarios, and PRZM Turf Modeling Scenarios to Date” by Elizabeth Leovey, Acting Director of Environmental Fate And Effect Division of the Office of Pesticides, Environmental Protection Agency, Washington D.C.

EFFD Guidance document. 2001. Guidance for selecting input parameters in modeling for environmental fate and transport of pesticides. Version II. December 4, 2001.

Appendix A

Florida Turf(2.00 lbs X 2X and 4.00 lbs X 1X applications)

Chemical: Oxadiazon
PRZM environment: FLOXATRF.inp
EXAMS environment: INDEXRES.EXV
Metfile: met156A.met

WATER COLUMN DISSOLVED CONCENTRATION (PPB)

YEAR	PEAK	96 HOUR	21 DAY	60 DAY	90 DAY	YEARLY
1948	242.000	236.000	215.000	180.000	160.000	50.980
1949	112.000	109.000	101.000	90.350	83.690	63.400
1950	74.410	72.960	68.120	58.650	53.490	38.110
1951	73.530	72.160	66.680	56.480	51.260	39.540
1952	210.000	205.000	187.000	154.000	139.000	63.590
1953	105.000	103.000	99.710	87.230	79.180	60.070
1954	92.800	91.020	85.580	77.490	71.290	53.220
1955	63.750	62.710	59.680	53.670	49.610	40.750
1956	55.700	54.680	52.380	50.060	47.080	33.150
1957	161.000	157.000	143.000	119.000	112.000	66.870
1958	169.000	166.000	151.000	129.000	115.000	66.050
1959	113.000	111.000	104.000	89.500	82.190	59.850
1960	140.000	137.000	128.000	116.000	106.000	67.850
1961	85.600	84.050	78.420	73.590	68.740	52.540
1962	68.250	67.010	62.160	56.550	56.250	42.300
1963	111.000	109.000	102.000	88.070	78.290	49.370
1964	107.000	105.000	96.260	90.100	86.820	60.240
1965	148.000	145.000	133.000	122.000	108.000	62.890
1966	109.000	107.000	100.000	94.900	87.020	71.590
1967	109.000	107.000	103.000	95.120	88.300	65.750
1968	112.000	111.000	108.000	101.000	94.220	67.920
1969	79.310	78.140	72.690	63.590	56.750	45.180
1970	98.620	96.960	90.130	76.970	69.270	50.640
1971	84.820	83.200	77.290	68.930	63.760	44.640
1972	93.450	91.590	84.920	79.580	74.520	48.020
1973	50.060	49.180	46.770	42.220	39.300	31.670
1974	63.840	62.890	58.230	49.290	46.990	34.390
1975	40.150	39.430	36.700	32.370	31.470	26.370
1976	54.370	53.310	49.600	45.990	43.700	33.380
1977	235.000	232.000	214.000	198.000	181.000	87.790
1978	67.640	66.730	63.140	56.240	52.850	40.150
1979	185.000	181.000	170.000	144.000	130.000	73.100
1980	84.110	82.580	78.420	70.970	64.470	53.390
1981	101.000	99.370	92.320	78.970	72.440	47.590
1982	107.000	105.000	102.000	96.830	92.650	59.920
1983	54.200	53.310	50.180	46.460	45.450	39.870

SORTED FOR PLOTTING

PROB	PEAK	96 HOUR	21 DAY	60 DAY	90 DAY	YEARLY
0.027	242.000	236.000	215.000	198.000	181.000	87.790
0.054	235.000	232.000	214.000	180.000	160.000	73.100

0.081	210.000	205.000	187.000	154.000	139.000	71.590
0.108	185.000	181.000	170.000	144.000	130.000	67.920
0.135	169.000	166.000	151.000	129.000	115.000	67.850
0.162	161.000	157.000	143.000	122.000	112.000	66.870
0.189	148.000	145.000	133.000	119.000	108.000	66.050
0.216	140.000	137.000	128.000	116.000	106.000	65.750
0.243	113.000	111.000	108.000	101.000	94.220	63.590
0.270	112.000	111.000	104.000	96.830	92.650	63.400
0.297	112.000	109.000	103.000	95.120	88.300	62.890
0.324	111.000	109.000	102.000	94.900	87.020	60.240
0.351	109.000	107.000	102.000	90.350	86.820	60.070
0.378	109.000	107.000	101.000	90.100	83.690	59.920
0.405	107.000	105.000	100.000	89.500	82.190	59.850
0.432	107.000	105.000	99.710	88.070	79.180	53.390
0.459	105.000	103.000	96.260	87.230	78.290	53.220
0.486	101.000	99.370	92.320	79.580	74.520	52.540
0.514	98.620	96.960	90.130	78.970	72.440	50.980
0.541	93.450	91.590	85.580	77.490	71.290	50.640
0.568	92.800	91.020	84.920	76.970	69.270	49.370
0.595	85.600	84.050	78.420	73.590	68.740	48.020
0.622	84.820	83.200	78.420	70.970	64.470	47.590
0.649	84.110	82.580	77.290	68.930	63.760	45.180
0.676	79.310	78.140	72.690	63.590	56.750	44.640
0.703	74.410	72.960	68.120	58.650	56.250	42.300
0.730	73.530	72.160	66.680	56.550	53.490	40.750
0.757	68.250	67.010	63.140	56.480	52.850	40.150
0.784	67.640	66.730	62.160	56.240	51.260	39.870
0.811	63.840	62.890	59.680	53.670	49.610	39.540
0.838	63.750	62.710	58.230	50.060	47.080	38.110
0.865	55.700	54.680	52.380	49.290	46.990	34.390
0.892	54.370	53.310	50.180	46.460	45.450	33.380
0.919	54.200	53.310	49.600	45.990	43.700	33.150
0.946	50.060	49.180	46.770	42.220	39.300	31.670
0.973	40.150	39.430	36.700	32.370	31.470	26.370
1/10	192.500	188.200	175.100	147.000	132.700	69.021

MEAN OF ANNUAL VALUES = 52.559

STANDARD DEVIATION OF ANNUAL VALUES = 14.081

UPPER 90% CONFIDENCE LIMIT ON MEAN = 56.034

EEC calculations:

FOR Tees and Greens

Acute EEC = (1/10 peak value)(Percent area for Green & Tee)
= (192.5 μg/L)(0.04) = 7.70 μg/L

Non-cancer Chronic EEC =(1/10 yearly value)(Percent area for Green & Tee)
(69.02 μg/L)(0.04) = 2.76 μg/L

Cancer chronic EEC = (Mean of annual value)(Percent area for Green & Tee)
(52.56 μg/L)(0.04) = 2.10 μg/L

FOR Fairways

Acute EEC = (1/10 peak value)(Percent area for Fairway)
= (192.5 µg/L)(0.23) = 44.28 µg/L

Non-cancer Chronic EEC =(1/10 yearly value)(Percent area for FAirways)
(69.02 µg/L)(0.23) = 15.87 µg/L

Cancer chronic EEC = (Mean of annual value)(Percent area for Fairways)
(52.56 µg/L)(0.23) = 12.08 µg/L

FOR Roughs

Acute EEC = (1/10 peak value)(Percent area for Roughs)
= (192.5 µg/L)(0.67) = 128.65 µg/L

Non-cancer Chronic EEC =(1/10 yearly value)(Percent area for Rough)
(69.02 µg/L)(0.67) = 46.24 µg/L

Cancer chronic EEC = (Mean of annual value)(Percent area for Rough)
(52.56 µg/L)(0.67) = 35.22 µg/L